Lighting for Tension in Video Games

SIMAL AKAY

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by Şimal Akay

Tutor : Michael Immecke

Abstract

This thesis aims to analyze the "tension" in video games by using an experiment-based practical approach. It examines different lighting conditions and how people perceive them in virtual environments. *"Flow Theory"* and "*Circumplex Model*" are used as theoretical frameworks to define the term tension and serve as the basis of the experiment. For the experiment, a scene is created primarily inspired by the video game *Resident Evil: Village*. Different lighting conditions are applied to the scene in order to understand how lighting qualities can invoke various emotions in the context of tension. A survey is conducted on people with diverse backgrounds to observe their reactions and understand their perception of their surroundings.

Keywords: Emotional Response, Perception, Lighting Qualities, Immersion

Acknowledgements

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1. INTRODUCTION

With the development of technology, many innovations are now entering our lives. Day by day, virtual environments are becoming a more integrated part of daily routine. Especially since the start of the pandemic in 2020, we started to spend more time with technology and it's still evolving. Architectural lighting is a factor that affects our perception at every moment in our lives. It helps us to see and define our surroundings and the objects around us. It also affects our psychological moods and emotions. According to Barrett (2017), events in the world stimulate emotional responses in us. She explains that the brain adds meaning to sensations from your body as well as sight, sound, smell, and other stimuli from the outside world. As a result, the brain constructs the occasion of emotions. Light is one of the factors that define our surroundings. Therefore, parameters such as the color of the light, the shadow, the light distribution, and light intensity can all have an impact on our feelings. Moreover, the degree of arousal[1] created by external factors such as light is also effective in the formation of emotions.

The use of lighting becomes ever more present in emerging areas such as video games. Video games is one of the mediums where it offers different perspectives on the blending between architectural principles and lighting. Conveying emotions in a game is an important factor in both increasing the pleasure of the experience and creating immersion for the players. Houze (2019) mentions that setting up the right atmosphere with the right lighting in a game is very important for emotional connection. And unlike movies, movement in video games is a "key ingredient that enables acting upon the environment and thus the pre-requisite for a sense of agency that is a crucial factor" (Calleja, 2007).

This thesis will examine how the "tension" feeling is conveyed via lighting in the context of video games. It will focus on analyzing the effects of lighting on people when they are exposed to various degrees of stimulating and disturbing factors in three different scenes. In addition, the thesis aims to explore how these lighting conditions affect one's well-being and mental health.

1.1 Lighting Use in Films

Lighting is a very important concept, especially in the film industry. With the lighting, the attention of the audience can be drawn to the desired place or it can give important information about what will happen. It can be used as a tool to guide the eye. But more importantly, it can be used to evoke emotions. According to Dang (n.d) there are 4 main elements of lighting in the film industry that influences the mood. These are;

1- Direction of light: It relates to where the light source is positioned in relation to the topic.
2- Quality of light: It refers to the intensity of light.
3- Source of light: It refers to the role of the lighting.
4- Color of light: refers to the color of the lighting.

With the use of these techniques, many feelings can be conveyed. With the direction of light, the volumes of an object or a person can be changed. It also has an influence on shadows. Due to that, a dramatic, monumental, or glamorous effect can be achieved.

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[1] to make somebody have a particular feeling or attitude (Oxford Dictionary, n.d).

The intensity can be changed in order to create contrast for a dramatic atmosphere or play with the diffusion of the light to create a magical atmosphere.

The source of light is mostly used to play with the amount of shadows and the contrast in the scene. Different types of lighting can be used to create a sense of mystery or as a neutralizer to have a neutral balance or to emphasize a subject (details of these kinds of lighting can be seen in Appendix). One of the most effective methods for emotions is to use different colors for light. For example, warm light can create a happy feeling while cold light can create an eerie feeling.

1.2 Circumplex Model

The circumplex model of affect is a model designed by Russell (1980) that rates the factors that affect emotions. Russell (1980) explains that, as defined by many psychologists, the phenomenon of affect consists of different dimensions and these dimensions are based on independent terms from each other such as displeasure, distress, depression, and excitement. Primarily, this model was proposed as a means for psychologists to represent the structure of affective experience as measured by self-report.In support of this model, 4 different methods including 28 different emotions were provided. In this thesis, I will be focusing on one of these techniques which are unidimensional scaling on hypothesized pleasure-displeasure and degree of arousal dimensions[Figure 1]. Moreover, this thesis will focus on the high arousal part of the model, taking into account the stimulating effect of light.
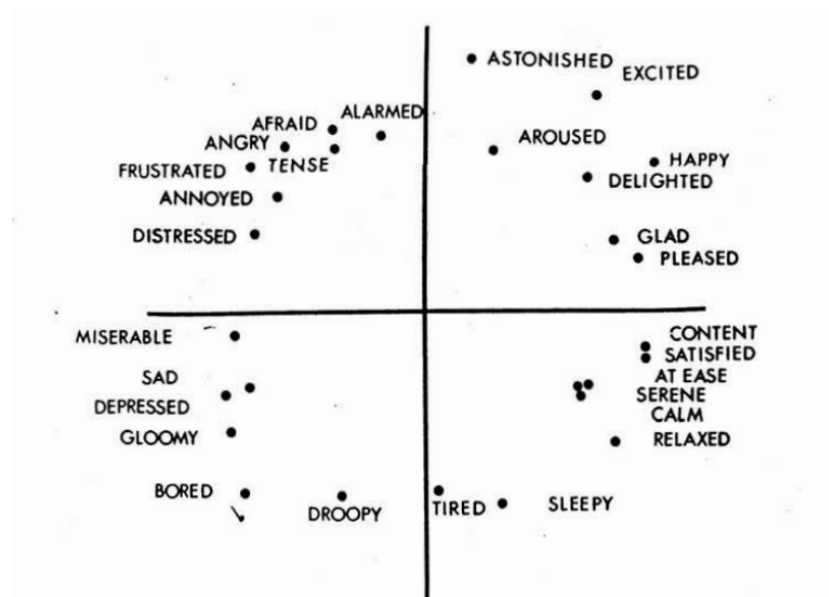

Figure 1
Unidimensional scaling of 28 affect words on pleasure - displeasure (horizontal axis) and degree of arousal (vertical axis)
[Figure adapted from Russel, J. A.(1980), A circumplex of model. pg.1169]

1.3 Flow Theory

Psychologist Mihaly Csikszentmihalyi introduced a term called "Flow Theory" in 1970's. He observed the people who did activities for pleasure. He investigated the reasons that made people enjoy the activity and made them keep on doing it. As a result, he understands that there is a feeling of "flow" that makes the participant do what they do constantly with pleasure. According to Csikszentmihalyi (1991), flow experience can be found in any activity. Hence, Csikszentmihalyi (1988, 1991,1993), demonstrated an illustration that explains the balance between the challenge and the skill in order to be in the flow area [Figure 2].
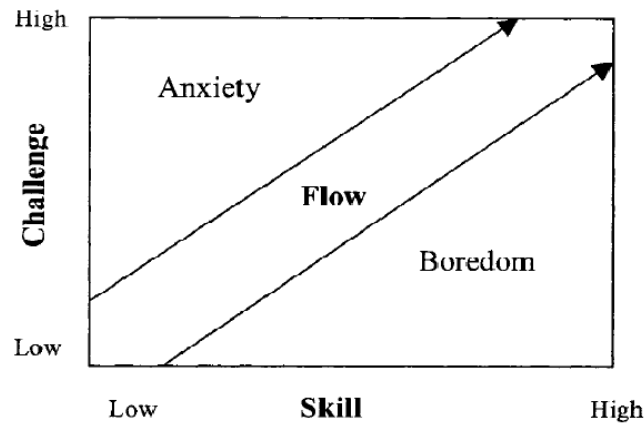

Figure 2
Flow Theory (Csikszentmihalyi, 1988, 1991, 1993 cited in Hood, 2007)

According to Figure 1, the flow theory is based on the relation between the capacity (skill) and the opportunity (challenge) of a given task. If a task is at a more challenging level than the person's ability, the person will feel anxiety while doing the job, and on the contrary, the person will feel boredom. Apart from this, In Figure 3 shows the advanced relationship between the skills and challenges (Csikszentmihalyi, 1997; Csikszentmihalyi, 2014).
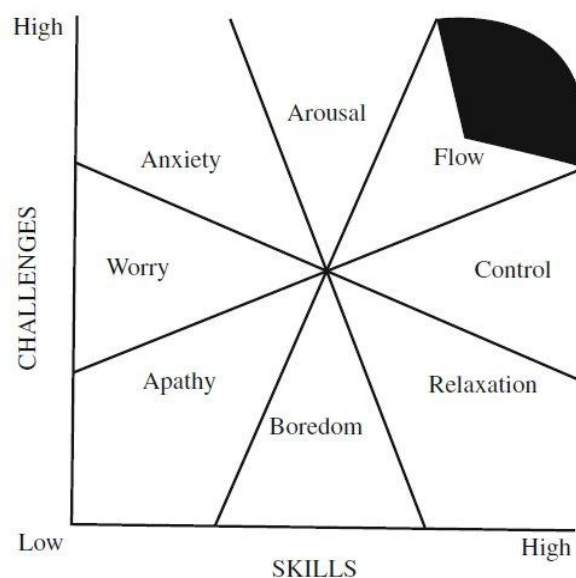

Figure 3
Refined Flow Model (Csikszentmihalyi, 1997; Csikszentmihalyi, 2014, p. 201)

According to Csikszentmihalyi, there are 8 elements of flow;
1. Clarity of goals and immediate feedback
2. A high level of concentration on a limited field
3. Balance between skills and challenge
4. The feeling of control
5. Effortlessness
6. An altered perception of time
7. The melting together of action and consciousness
8. The autotelic quality of flow experiences.

1.4 The Game

For this thesis topic, I was inspired by the game Resident Evil: Village. Resident Evil Village is a survival horror game released in 2021 by Capcom. The subject of the game begins with the cold-blood murder of the wife of our main character named Ethan Winters by his friend and the kidnapping of his baby girl. Ethan then battles werewolf-like mutants and creatures in a mysterious Central European village to find his daughter.

The game director Marimosa (2021) mentions that emotions are crucial for the development and progress of the game. He also says that "fear is born from the unknown, and you can't create tension by just adding more of the same experiment". In order to create a different experiment, they designed each area of the Village like a theme park to evoke a different emotion.
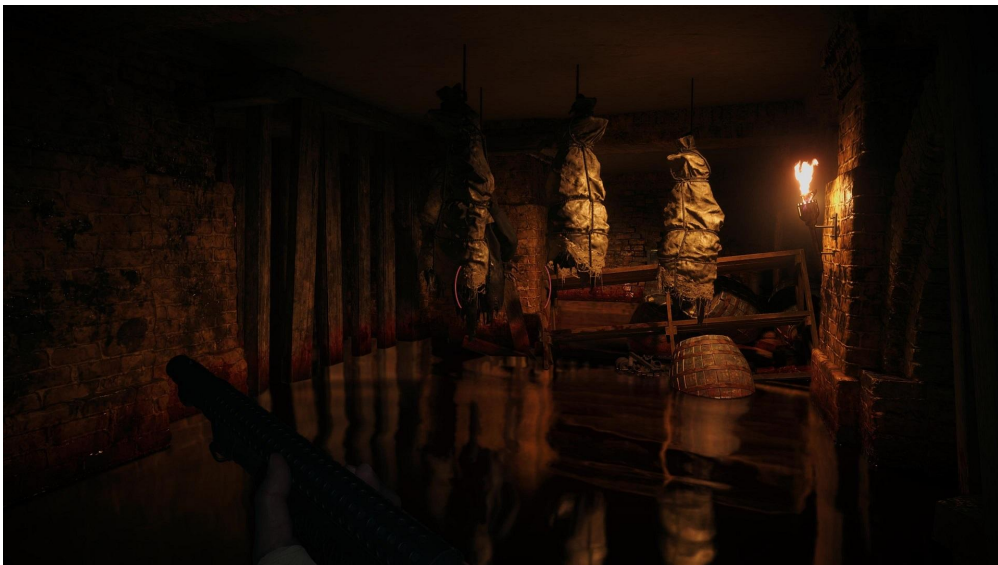

Image 1
Screenshot from the Resident Evil: Village ([URL: https://bit.ly/3MJmLnR)

The general setting of this game is a foggy, cold, old-looking village. However, in the village, there are different concepts and settings in line with the course of the game. One of the most effective ways to make a difference between these scenes and to create variation is the design and use of light. Apart from appealing to the emotions, it also provides a different atmosphere by creating certain contrasts between the scenes.

The chosen scene from the game for this thesis is called "Wine Cellar" [Image 1]. The character comes to this scene after fighting a vampire in a castle. Fighting with the vampire, one of the "main enemies", is a part that increases the tension and the pulse.

1.5 Sustainability Statement

The United Nations (UN) has identified 17 goals for sustainability. Goal 3: Good Health and Well-being is one the goals and lighting plays a highly important role. UN (2016) aims to treat "and promote mental health and well-being"(UN target 3.4). It affects our circadian rhythm and our mental health in many ways. Parameters such as light level, intensity, color, natural light or artificial light have different effects on our bodies, affecting even our hormonal systems. These hormonal secretions and the way we perceive the environment are effective in the formation of our emotions. For this reason, one of the sub-titles of the thesis is to question to what extent the application of light in a virtual environment based on real lighting principles affects human well-being. In addition, what kind of a physically impossible type of lighting plays a role in human perception in an environment based on the feeling of tension.
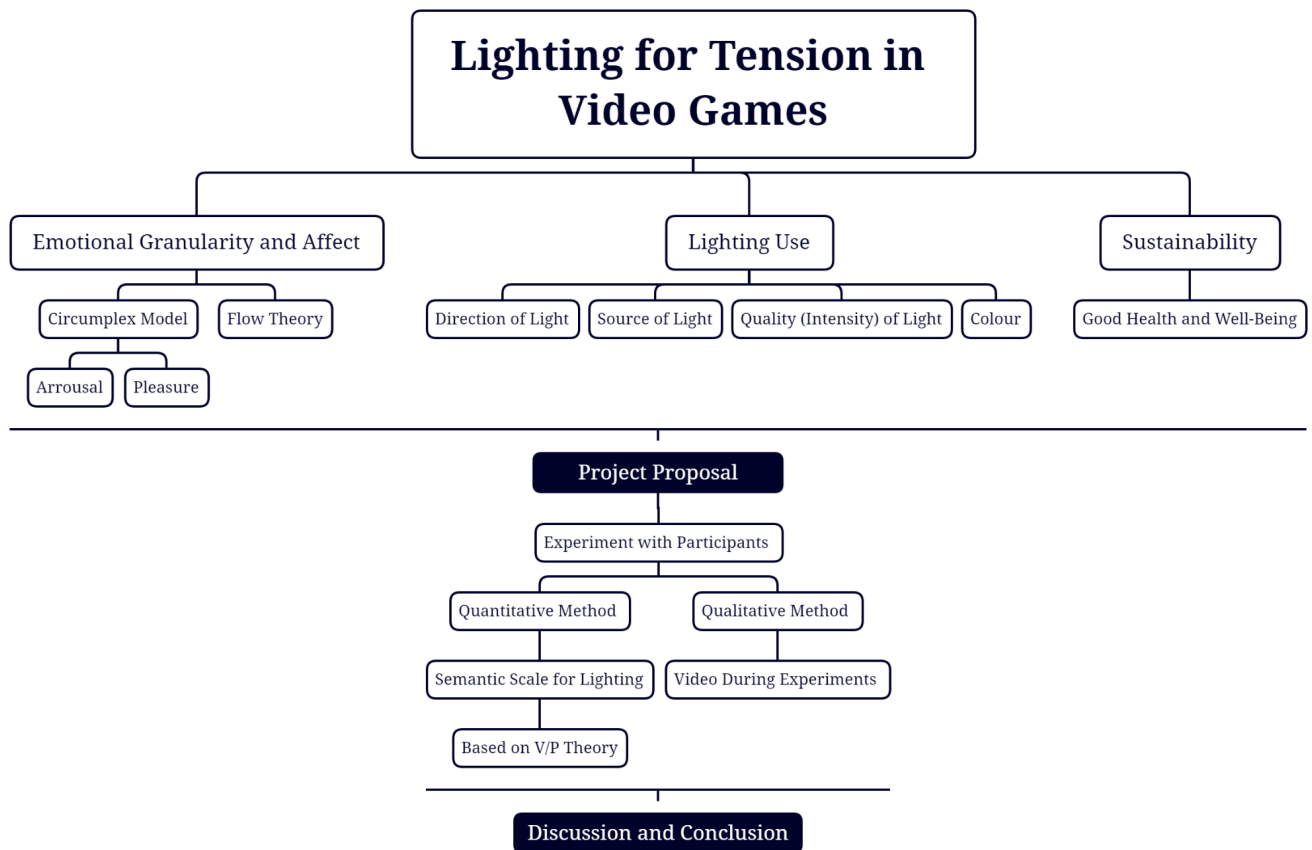
2. METHODOLOGY

Figure 4
Mind map containing the main topic of the thesis and research methods

The primary inspiration for the thesis is from a scene in the Resident Evil: Village game, called "Wine Cellar". The lighting setting of this scene consists of low lighting, high contrast, warm color temperature with brick walls and water element. The thick water element provides opaque reflections and makes it harder to predict what lies underneath it. These factors are also effective for the tense atmosphere. For the experiment, I recreated the same scenography with 3 different lighting conditions in order to rate the extent to which different light conditions affect the sense of tension [Figure 5,6].

All the scenes were arranged in such a way that they could be controlled by the participants in terms of the first-person player view. Participants have a 360-degree view and the opportunity to walk in the direction they want in the designated area.

After the experiment, a questionnaire in the form of a semantic scale (prepared on the basis of V/P Theory by Anders Liljefors (2015)) was applied to the participants. The V/P Theory includes 7 factors however, this thesis will focus on only 4 which are; light levels, shadows, reflections, and color tone of light. Therefore, the questionnaire includes only these 4 factors in order to analyze the data. Apart

from this, some of the participants, whose permission was taken, were videotaped during the experiment and their mimics and instant reactions were recorded to be analyzed.
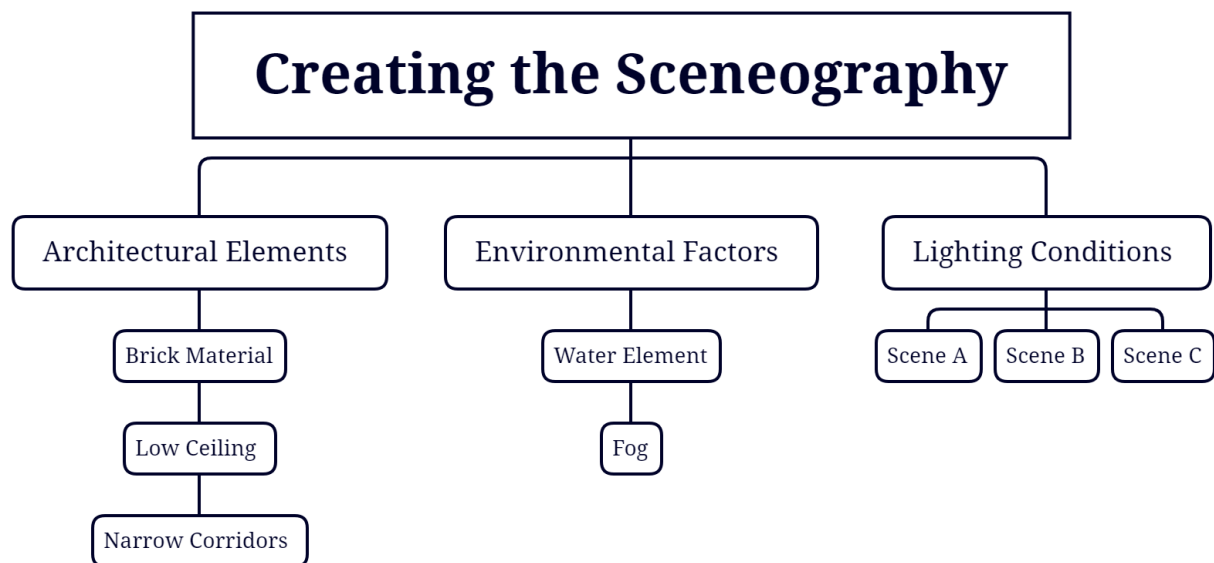
Creating the Sceneography

Architectural Elements
- Brick Material
- Low Ceiling
- Narrow Corridors

Environmental Factors
- Water Element
- Fog

Lighting Conditions
- Scene A
- Scene B
- Scene C

Figure 5

Mind map showing the essential factors for the scenography, which will be designed with different lighting

Lighting Conditions

Scene A
- Torch Lights + Candle Lights
- Low Brightness
- Avarage Contrast

Scene B
- Flashlight Only
- White Light
- High Contrast

Scene C
- Physically Impossible Light
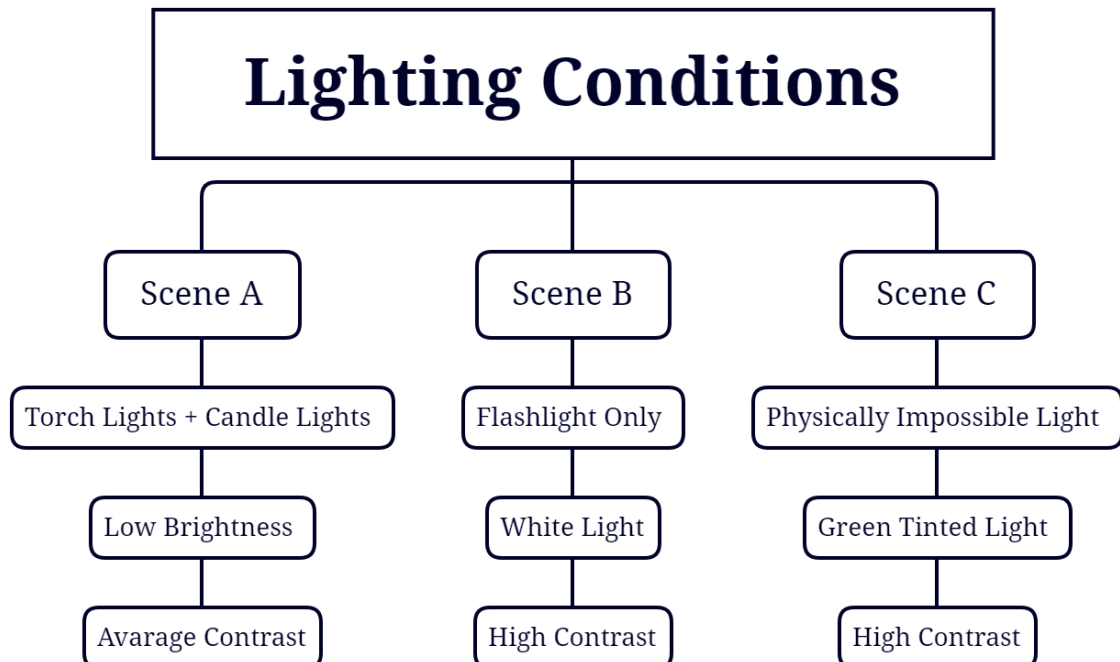- Green Tinted Light
- High Contrast

Figure 6

Different variations of the scenes according to lighting design

2.1 Design Process

After choosing the "Wine Cellar" scene from the *Resident Evil: Village* game, the scene is recreated using AutoCAD, 3Ds Max, Unity and Substance Designer. The 3D modeling of the scene is done in 3Ds Max [Image 2]. Lighting for the scene is authored in Unity. In Unity, it is possible to use Physically Based Rendering (PBR) which means that it provides a realistic environment and material use based on physically accurate light foundations. Moreover, the global illumination feature allows a system to model how light is bounced off of surfaces onto other surfaces (indirect light), rather than just the light that hits a surface directly from a light source (direct light).
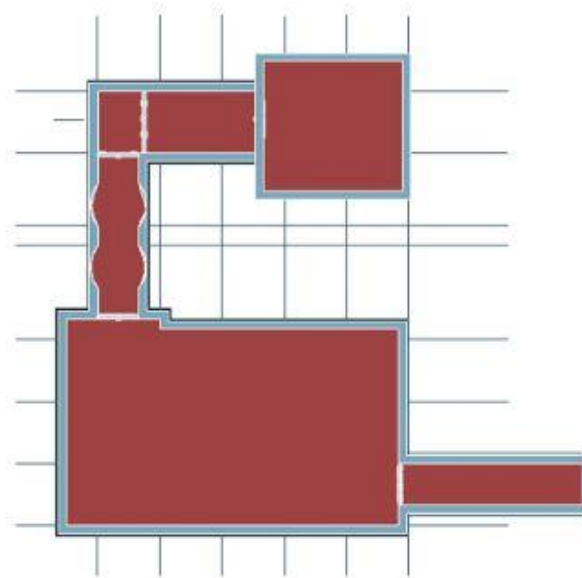

Image 2
WIP modeling of "Wine Cellar" plan view
Screenshot by the author

2.2 Creating the Scenes

Three different scenes were created in order to measure the tension of the lighting design on people. Scene A is almost the same as the original game. Similar to the game, flames from torches were used for ambient lighting [Image 3]. However, unlike the game, this scene relies on real-world physics laws for physical-based lighting and no rim or fill lights are used for artistic purposes. The color temperature of the candles are 1900 Kelvin and the intensity is 15 lm. As for the fire in torches, the color temperature is 1900 Kelvin and the intensity is set as 125 lm. (Papadopoulos & Earl, 2009).

In Scene B, torch lights were removed to increase the sense of uncertainty and curiosity. Instead, a flashlight is given to the player in the same environment [Image 4]. The flashlight has a cold color temperature, which is 6000 Kelvin with 80 lm.

Scene C is created to understand the effect of an unusual lighting condition on the participants. Similar to Scene 2, the flashlight is used as the main light source. However, the color of the light has been changed to green color [Image 5]. The color green is used in this scene in order to see the influence of a color that has a low arousal effect.

Image 3

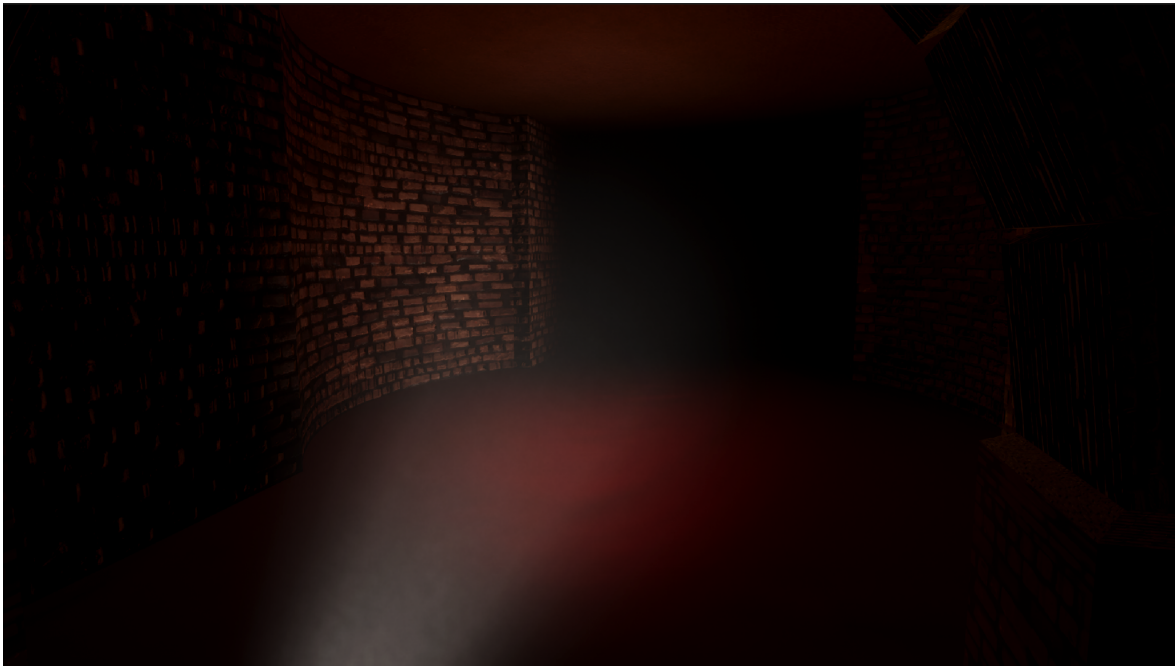Scene A screenshot - Fire from the torches as the main lighting source

Image 4

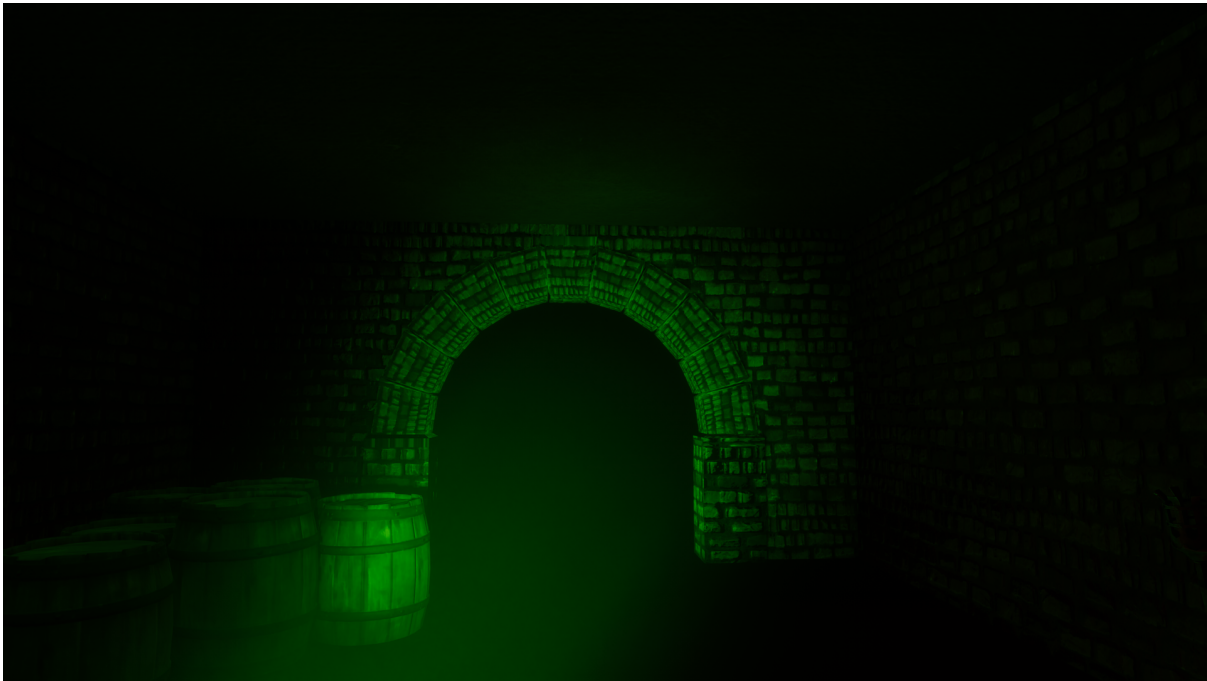Scene B screenshot - Spotlight as the main lighting source

Image 5
Scene C screenshot- Green-colored flashlight as a light source

2.3 **Participants**
In total 30 people participated in the survey. 7 out of 30 agreed to be videotaped during the experiment. The age range of the participants is between 19 and 53. Participants consist of different backgrounds. In addition, the player background of the participants is taken into account in the survey.

 2.4 Procedure
All of the scenes were collected in one file and shared over the internet. (social media). All participants performed the experiment from their own computers. At the end of the experiment, a survey questionnaire is placed as a link and all participants were asked to fill out this form. The questionnaire consists of 2 parts. The first part is more about understanding what kind of emotions are evoked in different scenes.

The second part of the questionnaire is based on V/P Theory factors (see Appendix II), in order to create a link between affects and characteristics of light.
Each participant experimented with the scenes in random order. Each scene had a maximum of 4 minutes to observe the scene. If they get lost and couldn't reach the ending point, the scene changes to the next one automatically. All the participants reached the ending point within the given time.

7 of the overall participants agreed to be recorded while experimenting. They constantly described verbally what they are feeling while playing the scenes.

2.5 Limitations

The sequence of the scenes was randomly arranged for each participant. It was not scripted, so that unique perspectives for each scene were captured. For the experiment, no sound or background music was added. This was done to avoid any distractions and it was an intentional choice so that all the participants can focus solely on the lighting conditions.

3. RESULTS

Thanks to the experiment and survey, information was obtained about the effects of different lighting conditions applied in video games, especially for tension.
Based on participants' answers to the survey, more than half of them play video games every day or twice a week.
Reading the survey results, it is observed that while Scene A is the scene that the participants enjoyed the most, Scene C is the scene that they felt aroused the most [Table 1].

Name of the Scenes	A	B	C
Number of Participants Who Enjoyed the Most	19	7	4
Number of Participants Who Aroused the Most	9	7	14

Table 1: Joy and arousal level among participants. N: 30

The "tension" that they felt in each scene is varied. Participants found Scene C as the most tense scene which consists of the green-colored flashlight as the light source. Scene B is the second most tense scene with the white-colored flashlight. Scene A is the third tense scene with fire torches. However, although the majority of the participants felt moderately tense in Scene A, 11 of the 30 participants didn't feel any tension at all in this scene.

Participants felt different levels of tension in each scene. They were asked to rate their level of tension for each scene on a scale of 1 to 5 (1 is considered as not at all and 5 is considered as very much). In Scene A 10 out of 30 people felt tension on an average level whereas 11 people felt no tension at all. In Scene B, most of the participants rated their level of tension as 4 out of 5. Scene C is the most tense scene rated by the participants. 15 people out of 30 rated their level of tension 5 out of 5 [Figure 7].
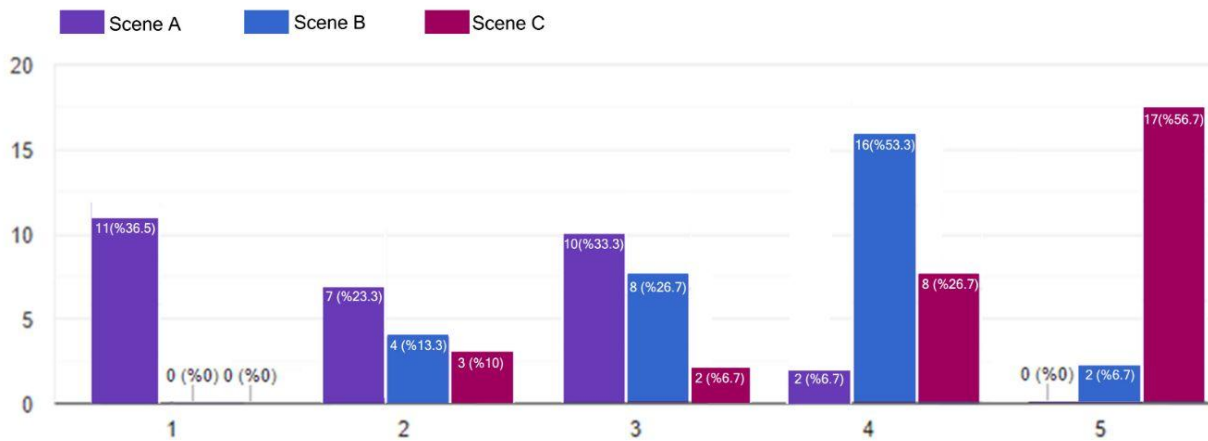
Figure 7 : Level of tension for each scene among participants

Participants were also requested to rate the level of immersion that they felt in all the scenes.
In Scene A, most of them (16 out of 30) felt fully immersed. 11 of them felt somewhat immersed and only 3 of them felt no immersion at all.

In Scene B, the majority (17 out of 30) felt somewhat immersed, 10 of them felt fully immersed, and only 3 of them felt no immersion at all.

In Scene C, 15 participants out of 30 felt fully immersed, 9 of them felt somewhat immersed and 6 of them felt no immersion at all [Table 2].

Name of the Scenes	A	B	C
Fully Immersed	16	10	15
Somewhat Immersed	11	17	9
Not Immersed at All	3	3	6

Table 2: Level of Immersion among participants. N: 30

Participants' perceptions about the size of the space changed depending on the lighting conditions. The majority of the participants perceived Scene A wide, and Scene B narrow as well as Scene C. However, in Scene C, a considerable number of people (11 out of 30) perceived the space as very narrow [Table 3].

Name of the Scenes	A	B	C
Very Narrow	1	3	11
Narrow	3	20	15
Wide	19	6	3
Very Wide	7	1	1

Table 3: Perception of the size of each scene among participants. N:30

The second part of the questionnaire was based on V/P Theory. 4 factors out of 7 were asked to participants. The goal was to evaluate their perception of the scenes. The selected 4 factors are;
- Light levels (amount of light on the surfaces)
- Shadows
- Water Reflections
- Color tone of light

For Scene A; most of the participants found the light levels slightly bright, shadows slightly diffused, water reflections slightly sharp, and the color tone of light warm [Figure 8].
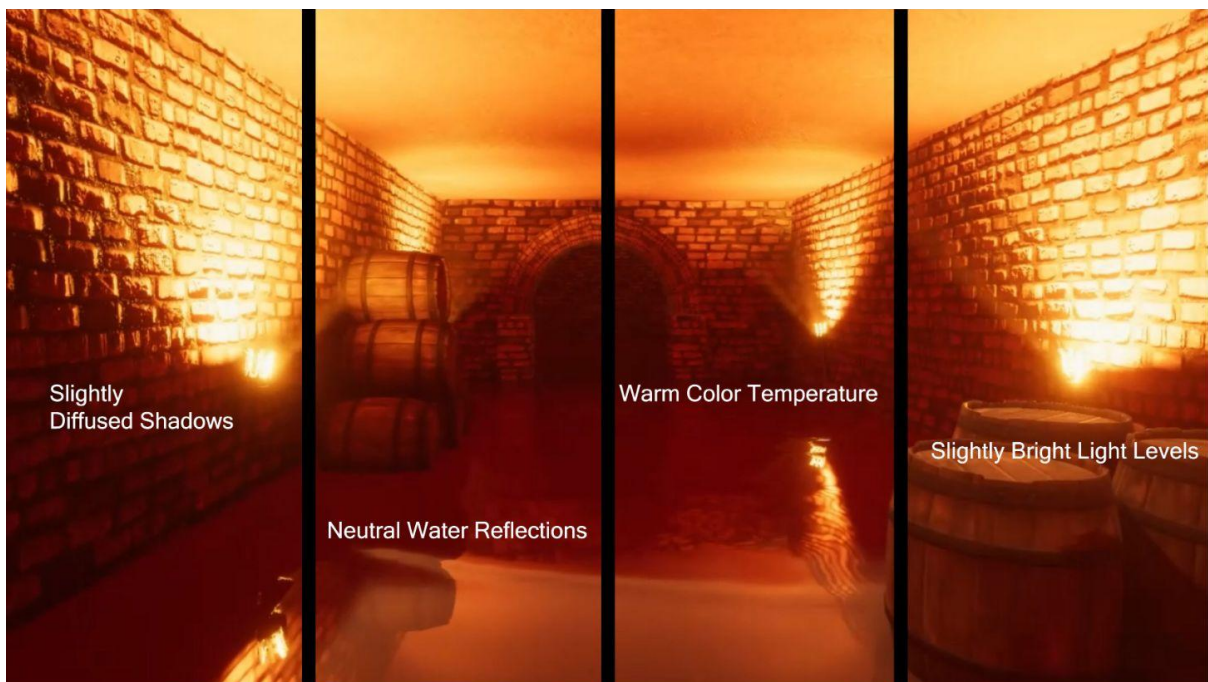

Figure 8
The figure shows which perception factors got selected the most by the participants to define the characteristics of scene A (For detailed results, see Appendix I)

In Scene B; 15 participants out of 30 found the light levels slightly dark. The perception of the shadows was separated into 2; 8 out of 30 said neutral and 8 out of 30 said slightly dark. The majority (13 out of 30) found water reflections neutral and the color tone of light again neutral (12 out of 30) [Figure 9].
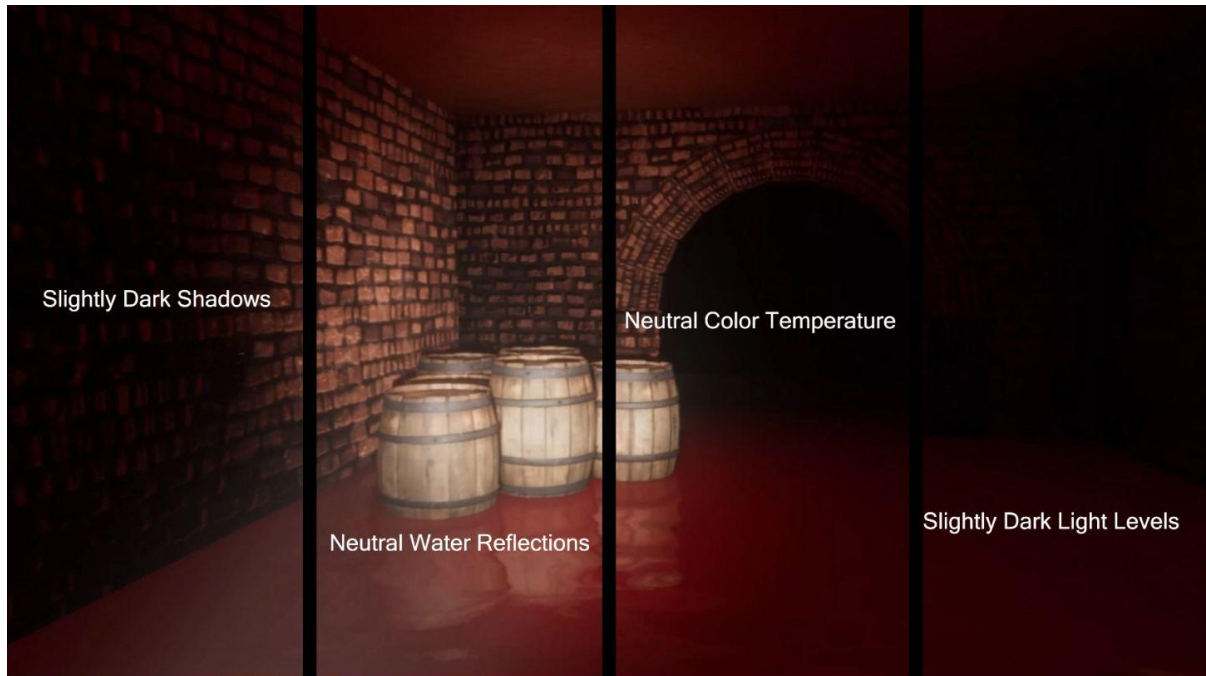

Figure 9
The figure shows which perception factors got selected the most by the participants to define the characteristics of the scene B
(For detailed results, see Appendix I)

In Scene C, most of the participants (19 out of 30) found the light levels very dark, shadows slightly dark (9 out of 30), water reflections very soft (11 out of 30) and the color tone of light slightly cold (12 out of 30) [Figure 10].
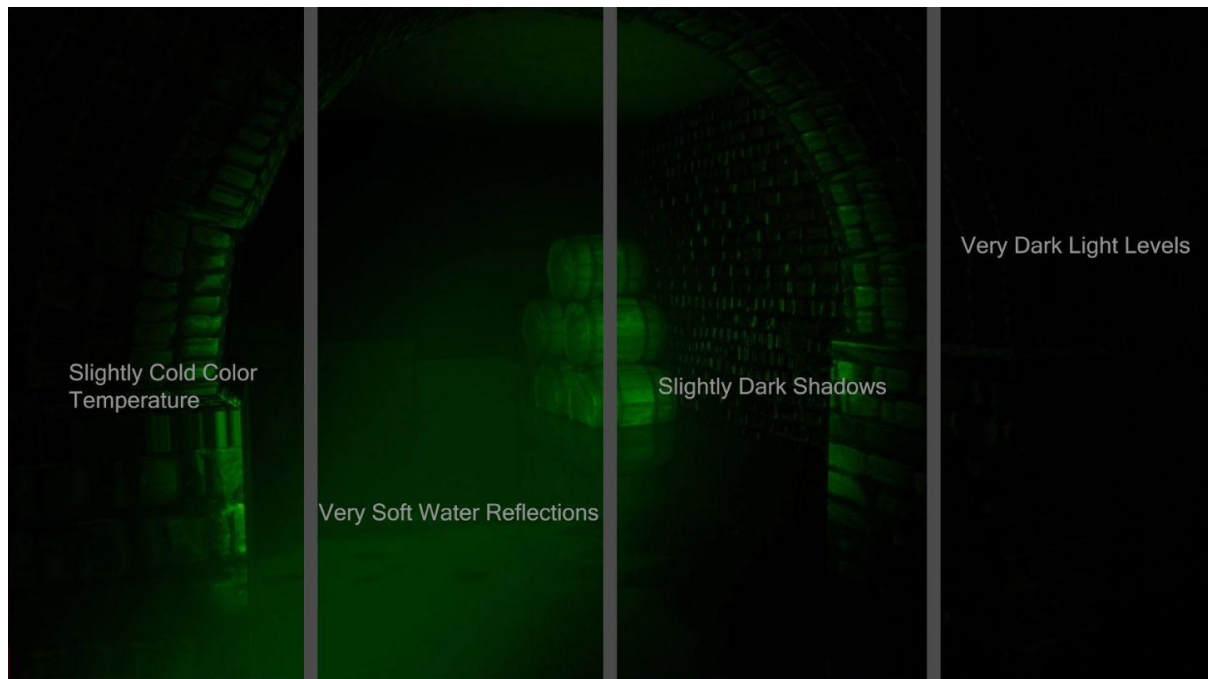
Figure 10
The figure shows which perception factors got selected the most by the participants to define the characteristics of the scene C
(For detailed results, see Appendix I)

7 participants out of 30 agreed to be recorded during their experiment. With the use of the recording, I had the chance to collect additional data based on their instant reactions, commentary and facial expressions.

As a general outcome, participants who experienced Scene B and Scene C before Scene A, felt relief when they experiment Scene A. They stated that they feel more "comfortable", "excited" and "happy" in Scene A. Even though they felt more comfortable, most of them still described the place as "on edge", "nervous" and "suspenseful".

All the participants felt like something would suddenly show up from the dark parts of the space or from the water in all scenes.

6 out of the 7 participants had the urge to run in order to get out of the space as soon as possible while they are experimenting with Scene B and Scene C. However, 1 participant felt the need to walk slowly and look all around with the torchlight carefully so that he knows what was around him before he moves.

During Scene A, some participants wondered what is the story behind the candle lights. Candle lights evoked curiosity in most of the participants. They associated the candlelights with "mystery", "creepy" and "witchcraft". 3 of the participants assumed that the place would smell. 2 of them presume that it would smell like dust and dirt. 1 participant presumes that the candles have a scent.

During Scene B, participants described their feelings as "stressful", "eerie", "claustrophobic", "desolate", and "suspenseful".

During Scene C, participants used the words such as "shiver on the back", "toxic", "ominous", "unnerving" and "uncomfortable".

4 out of 7 participants stated that they felt a difference in the water height when the light source changed to a flashlight (Scene B and Scene C).

All the participants had an instant reaction when Scene C appeared. They froze for a while and tried to understand the surroundings and the light source. 1 of the participants said that "it is really surprising that a green light increases the tension this much". He stated that Scene C is the most tense scene and he added that he would expect this effect from a red light but not green. In Scene C, the experience was so intense for some people that one of the participants even refused to move at the beginning.

Figure 11
Keywords used by participants to describe the emotions felt in the scenes.

4. DISCUSSION

4.1 Relationship Between Emotional Responses and Lighting Qualities

Based on the results, it is emphasized that there is a clear relationship between the arousal level and the enjoyment. To be specific, arousal level has an influence on the joy that people feel. Participants had the most arousal level in Scene C which made them uncomfortable, so they didn't enjoy the scene as much as the other scenes. However, there has to be a considerable level of arousal in order to make people enjoy the scene. When the arousal level is too low, as happened in Scene B, the number of participants who had enjoyed the scene is also low. However, in Scene A, there is a certain level of arousal value which also supports the number of people who had the most joy.

It is observed that if a person enjoys a scene, it decreases the tension. Some participants referred to Scene A with terms such as "happy", "excited", and "comfort". This indicates that people enjoyed the scene. The joy can also be related to the lighting characteristics of the scene. People mostly enjoy a scene where the light levels are slightly bright and when the surroundings are visible even though it is not fully illuminated. Results from Scene A also show that people enjoy being in an environment with warm color temperature.

According to the results, there is a correlation between the arousal level and tension. When the arousal level is high, the level of tension is also high. Hence, it is observed that these two factors decrease the feeling of joy. It is possible to say that one of the most important factors of tension is the light levels. The illumination of the surrounding has an influence on the shadows and reflections in the environment. When the light level is very dark, as stated by most of the participants for Scene C, it narrows down people's vision. Without a fair amount of light, shadows get darker and water reflections become softer. When the reflections become softer, it creates uncertainty. Therefore, people become more nervous and tense. For instance, in Resident Evil II: Remake, the player uses a spotlight as the single source of light [Image 6]. This is one of the most effective elements of the feeling of tension in the game. This limits player's perspective. Therefore, Houze (2019), explains that, due to the high contrast, the forced perspective directs the player's eye and eradicates everything outside of the light. Survey results also confirm that this kind of lighting in Scene B and Scene C increases both the level of tension and arousal.

Image 6
Resident Evil II: Remake by Capcom
[URL: https://bit.ly/3z0yj2h]

In accordance with the results, the color temperature of the light source has a link with the level of tension and the perception of the space. In Scene A, torches (1900K) and candlelights (1800K) were used for the illumination of the space. Participants rated the scene as warm and wide. In Scene B and Scene C hand torchlight was used as the main light source. In both of the scenes, the intensity, the range, and the color temperature (6000K) of the light source are the same [Figure 12]. The only changing variable is the color of the light source. (Scene B - neutral white light, Scene C - green light). Hence, participants perceived Scene C, as colder and more narrow than Scene B. This result indicates that the color of the light source has an effect both on the perception of the color temperature and the size of the space. Furthermore, it is highlighted that cold color temperature increases the level of tension, as we see in the results for Scene C.
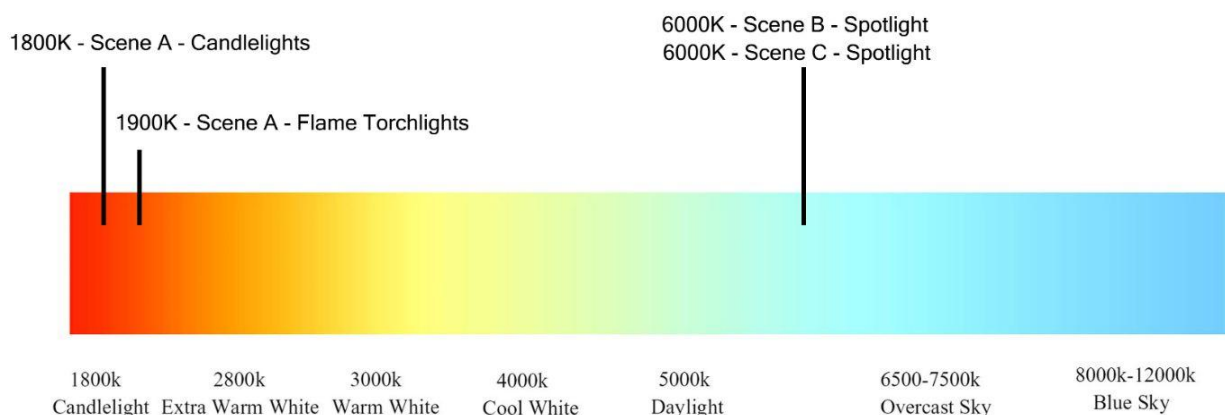

Figure 12
The figure shows the color temperature values (in Kelvin) for each scene, on the color temperature chart.

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The use of the color of the light source is another factor that affects the perception and emotional response. Each color has different meanings and impressions on human psychology. According to Cherry (2022), in color psychology, colors with long wavelengths are considered "arousing or warm," while colors with shorter wavelengths are considered "relaxing or cool." Green is one of the colors with short wavelengths and it reminds us of nature. Therefore, it is considered a calming and optimistic color. Moreover, depending on the culture, the green light usually indicates safety [see Appendix II] whereas the red color indicates danger. In light therapy, green light is mostly used to reduce pain and migraine (Cherry, 2022). Similar to this, green light is also used to accentuate the nature and immaturity in the film industry.

However, green light can also be used to convey a sense of danger, darkness, mystery, or corruption when the ambiance is illuminated with dim light sources that create high contrast. For instance, Alfred Hitchcock was one of the directors who used different colors and filters to enhance the feeling in his scenes. In "Vertigo"(1958), he uses green filters to create different meanings. According to Tet (2020), Hitchcock uses green-tinted filters in order to create mystery and also provide a foggy, blurry effect for the scene [Image 7]. Based on the narration, it can also be said that the green haze is used to distort reality. Another example is Disney's Maleficient (2014). In this movie, Maleficent's green fire is used to represent darkness, evil, and danger (Risk, 2020). Likewise, this thesis demonstrates that the color green increased the level of arousal and decreased the level of joy for Scene C. It is clear that even though the green color has a short wavelength, it can also be used to increase arousal and tension. Similarly, a Playstation 4 game called "P.T." (2014) created by Konami and directed by Hideo Kojima has a scene where the tension increases when the color of the light source changes from neutral color to green light [Image 8].

Image 7
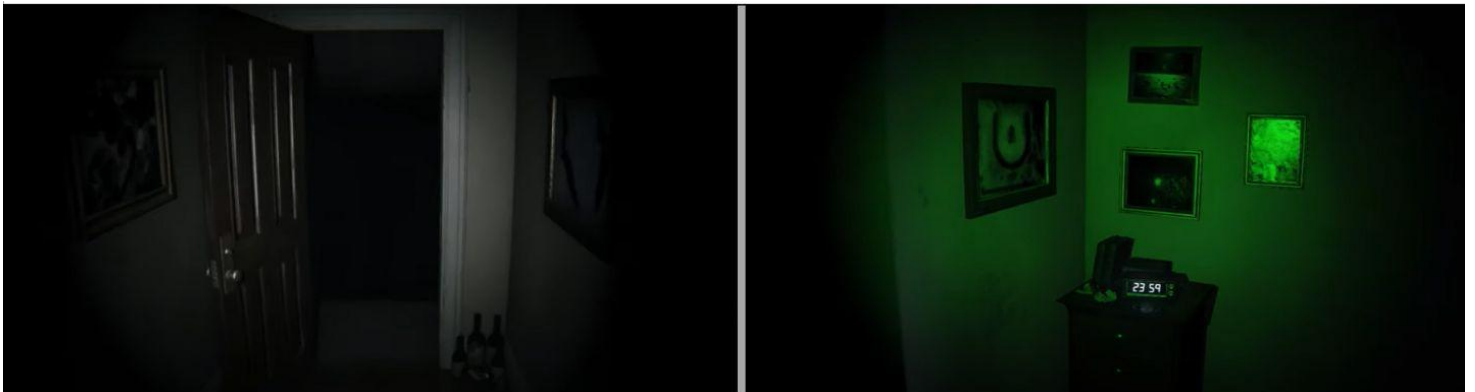"Vertigo" by Alfred Hitchcock (1958)
[URL:https://bit.ly/3PErI3c]

Image 8
Screenshots from the game "P.T." by Konami.

4.2 **Feeling of Immersion**

To make a participant fully immersed in a scene or in an environment, there has to be a factor that creates a considerable amount of arousal. In the survey, Scene A and Scene C have been selected as the most immersive scenes by the participants. According to the results from the survey, it can be outlined that the color temperature of the environment and the level of tension (they're mutually exclusive) have an influence on the level of immersion. However, it is important to emphasize that in order to be in the flow zone, the level of arousal should not be too high on the vertical axis (*challenge*) or too low on the horizontal axis (*skill*) [Figure 13].

Scene B has the least arousal level and participants mostly felt somewhat immersed in the scene. Thus, Scene B has the least number of participants who had enjoyed the scene. In Scene B, a flashlight is used as a light source. Although this light source narrows the vision of a player, the perceived color of the surroundings and the light made them feel more comfortable compared to Scene C. On the other hand, white light with 6000K made the shadows, water reflections and the color temperature of the scene look neutral. In Scene A, these factors are considered as diffused shadows, sharp reflections, and warm color temperature. In Scene C, they are rated as slightly dark shadows, soft reflections, and cold color temperature. Based on these results, it is proved that neutral looking of the shadows, reflections, and color temperature were perceived as ordinary. People feel more comfortable with the neutral color tone of light. Thus, it can be stated that participants did not feel that much arousal or joy [Figure 13] and can get bored.
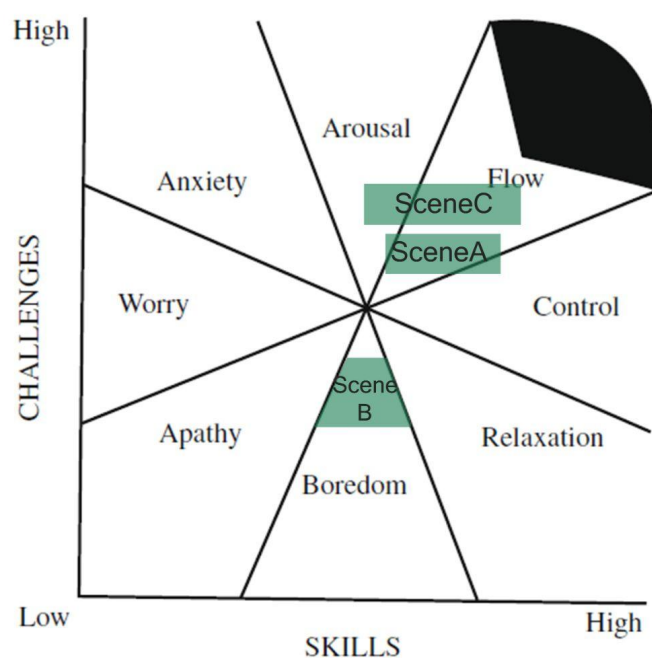

Figure 13

Approximately showing the level of immersion for every scene:

Scene B has neutral lighting conditions that participants are familiar with and requires low challenge, average skill. Therefore, the immersion level for the scene is the lowest (enters "boredom zone") among participants. Scene A and Scene C have different lighting conditions, however they either have a high level of joy or arousal.

When the parameters for lighting qualities shift to a more extreme value and become pronounced (i.e. when they become slightly darker/diffused, sharper/softer, and warmer/colder), it enhances the level of arousal. Therefore, these results point out that when people experience a scene with unusual lighting qualities that they are not familiar with, their level of joy or arousal increases. Consequently, this affects the level of immersion [Figure 13].

The level of immersion is one of the most important factors for the "Flow Theory". Isbister (2016) states that movies and novels have the ability to evoke emotional responses, they achieve an immersion level that makes a person feel the situation as if they were there. She (2016) also adds that it is quite possible to cry over something that happened in a film or a book. As outlined in the previous section (3), it is also observed that people react to a situation in a virtual environment. In the aforementioned examples, participants who had been recorded have an instant facial reaction of "surprise" and "scare" when they enter Scene C, which is defined as the most tense scene according to the survey results.

4.3 Conclusion

All in all, the thesis shows that there is a connection between lighting quality and its impact on the level of arousal and enjoyment. Lighting factors such as color temperature play a crucial role. It is observed that the cooler or warmer the color temperature becomes, the more it affects the level of arousal in an environment; whereas the effect of neutral white light (around 6000K) is negligible. It is perceived as ordinary by the participants so neutral light doesn't have any significant effect on the level of arousal. There is a correlation between the level of arousal and tension. A high level of arousal can evoke tension. Similarly, having either a high level of arousal or enjoyment also increases the level of immersion (as long as it stays in the flow zone).

In the context of lighting qualities, results demonstrated that cold color temperature can directly increase the level of tension. On the other hand, warm color temperature decreases the tension and boosts enjoyment. Consequently, the formula to achieve a scene with the highest level of tension via lighting qualities can be described as the one with a light source(s) that has a cold color temperature with the support of dark light levels, dark shadows, high contrast, and diffused reflections. Furthermore, creative authors should keep this in mind while they are crafting their experiences, that predominantly, the use of lighting with cold color temperature can lead to tense moments. This can be an intentional artistic choice but they should be aware and mindful of its consequences in the context of mental health.

This thesis explains how to create tension via lighting in video games. It sheds light on which factors convey tension and how they can become a part of creative authors' toolset. In video games, lighting artists can apply their learnings from this thesis to their projects in order to create tense moments. And in the future, using the qualitative and empirical data from this thesis, there's an opportunity for researchers to extrapolate results to other use cases such as VR or other interactive mediums. Using a similar methodology, other areas of emotions (i.e beyond tension) can also be studied.

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5.2 Ludography

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6. APPENDIX

6.1 Appendix I
Link to experiment:
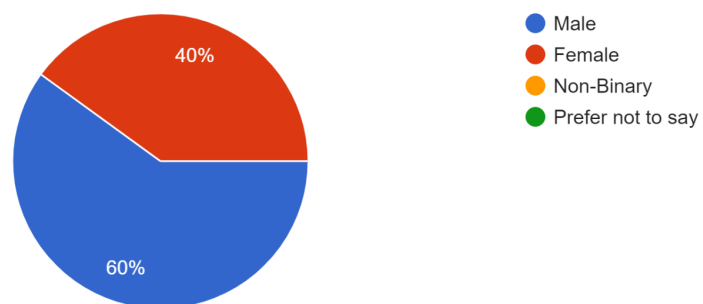https://drive.google.com/file/d/17YHm6v351zJJQKcTU1iti71103bRTBJC/view?usp=sharing

Below are the survey questions and answers;

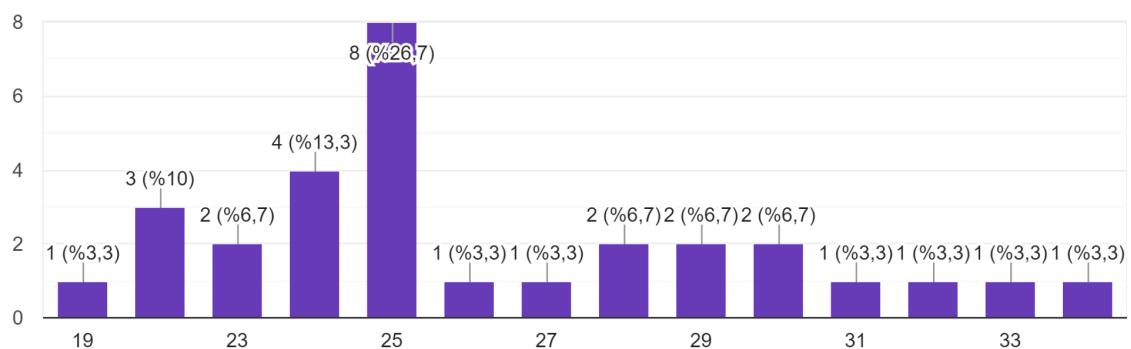## PART 1

Question 1

What is your gender?
30 yanıt

Question 2

How old are you?
30 yanıt

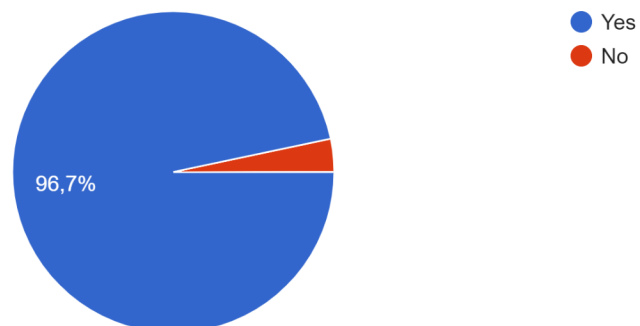**Question 3**

What is your profession?
These were the answers;

- Architect (x3)
- Student (x6)
- Architect & Lighting Design Student (x4)
- Business Informatics
- Game Engine Developer
- Game Dev/UI Developer (x3)
- Ground Handling Supervisor
- Interior Designer (x2)
- Key Account Executive
- Lighting artist
- Musician
- Retired Economist
- Selling Manager Assistant
- Software Engineer
- Technical Artist
- UI/UX Artist
- Chef (food industry)

In total: 30 participants

Question 4

Do you enjoy watching movies?
30 yanıt

96,7%

Yes
No

Question 5

How frequently do you play video games?
30 yanıt

- ● Every day
- ● Several times a week
- ● Once a week
- ● Once or twice a month
- ● Every couple months
- ● Once or twice a year
- ● Never

16,7%
10%
13,3%
10%
13,3%
30%
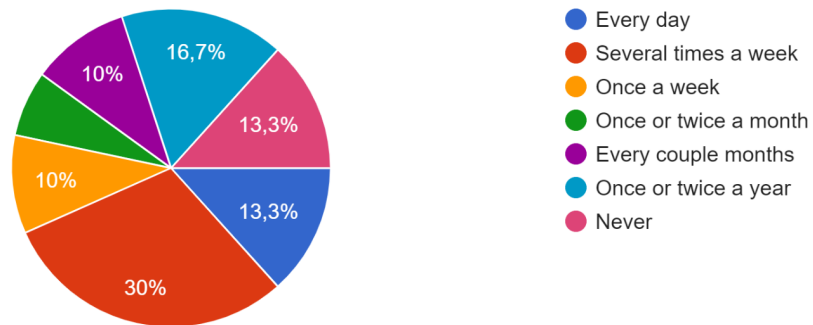
Question 6

Which scene do you enjoy the most?
30 yanıt

Scene C: 13.3%
Scene B: 23.3%
Scene A: 63.3%
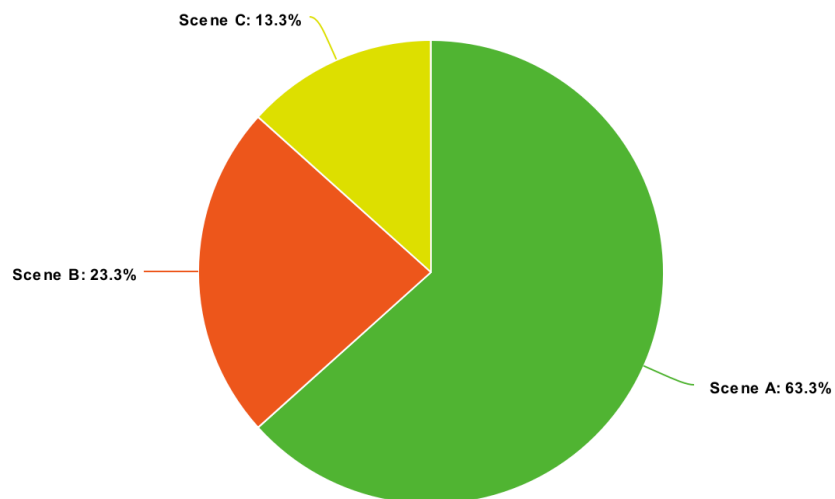
Question 7

Which one of the following scenes make you feel more aroused?
30 yanıt

Scene A: 30.0%

Scene C: 46.7%

Scene B: 23.3%
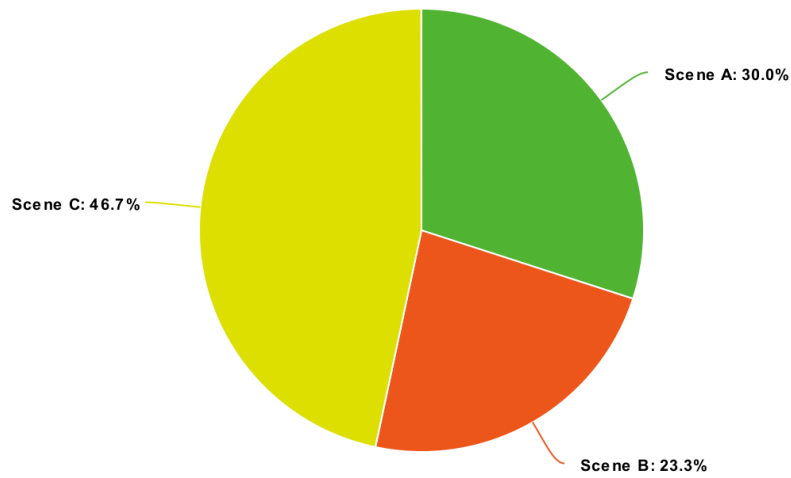
Question 8

How much tension did you feel during the scene A?
30 yanıt
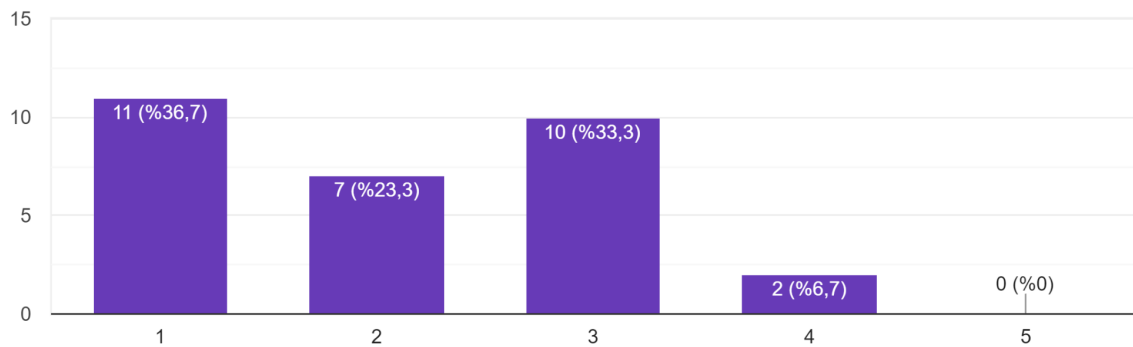
* A scale is used from 1 to 5: 1 rated as no tension at all, 5 rated as very much.

Question 9

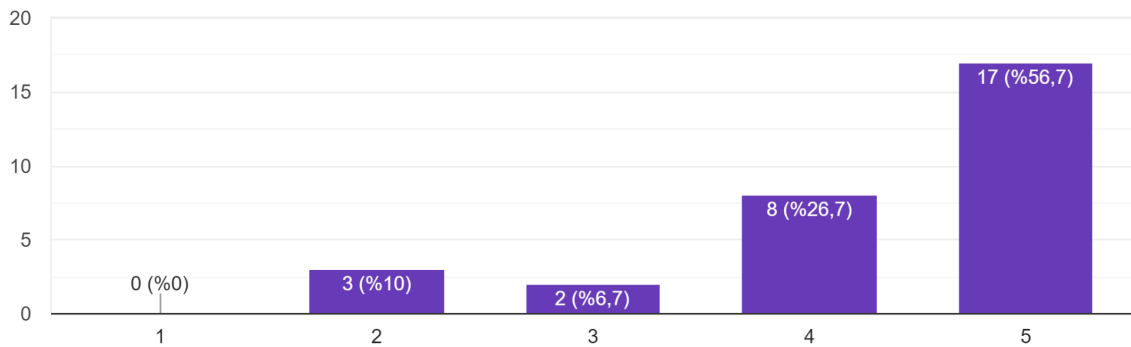How much tension did you feel during the scene B?

30 yanıt
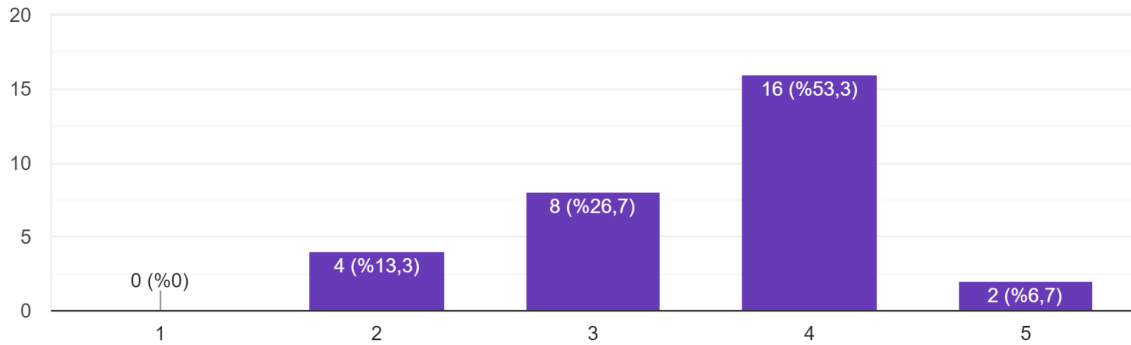
* A scale is used from 1 to 5: 1 rated as no tension at all, 5 rated as very much.

Question 10

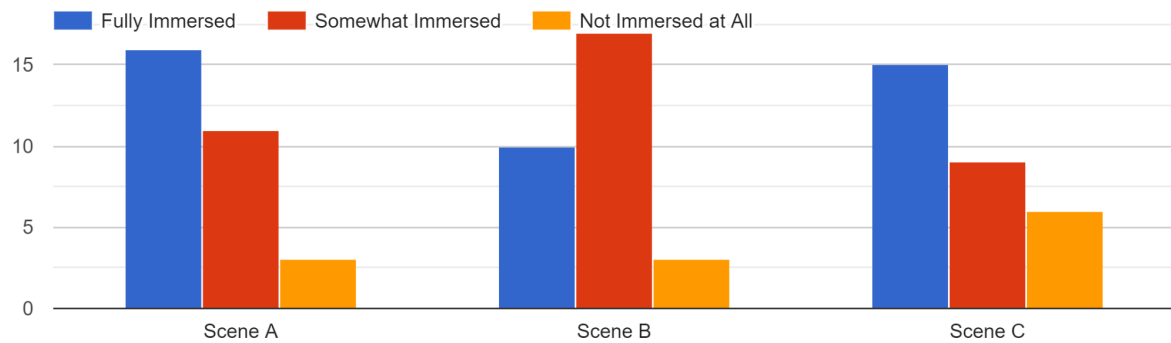How much tension did you feel during the scene C?

30 yanıt

* A scale is used from 1 to 5: 1 rated as no tension at all, 5 rated as very much.
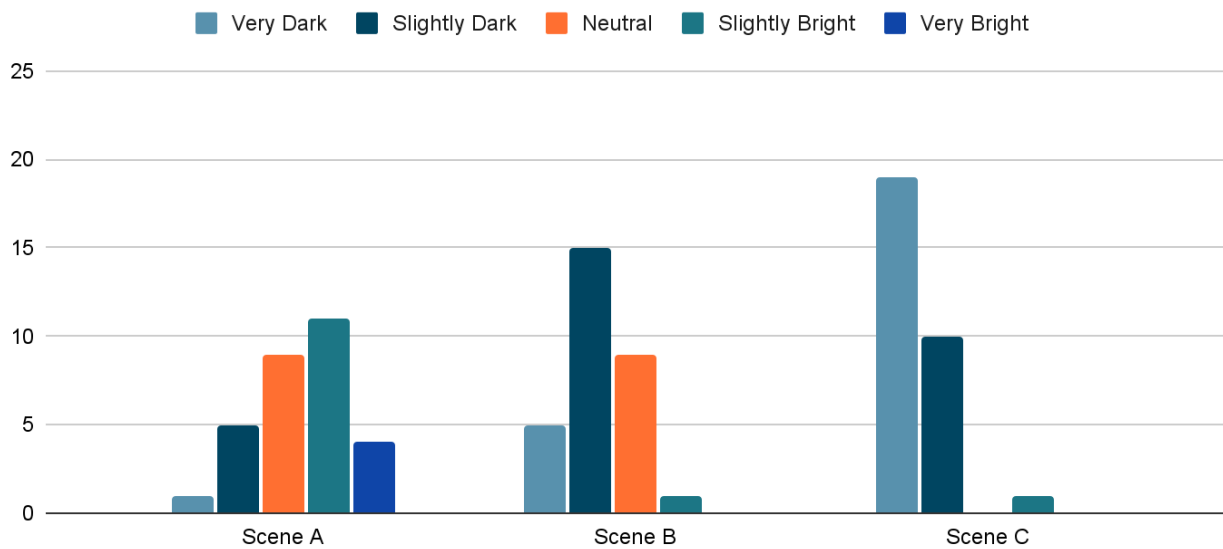
Question 11

Please rate the level of immersion in all scenes
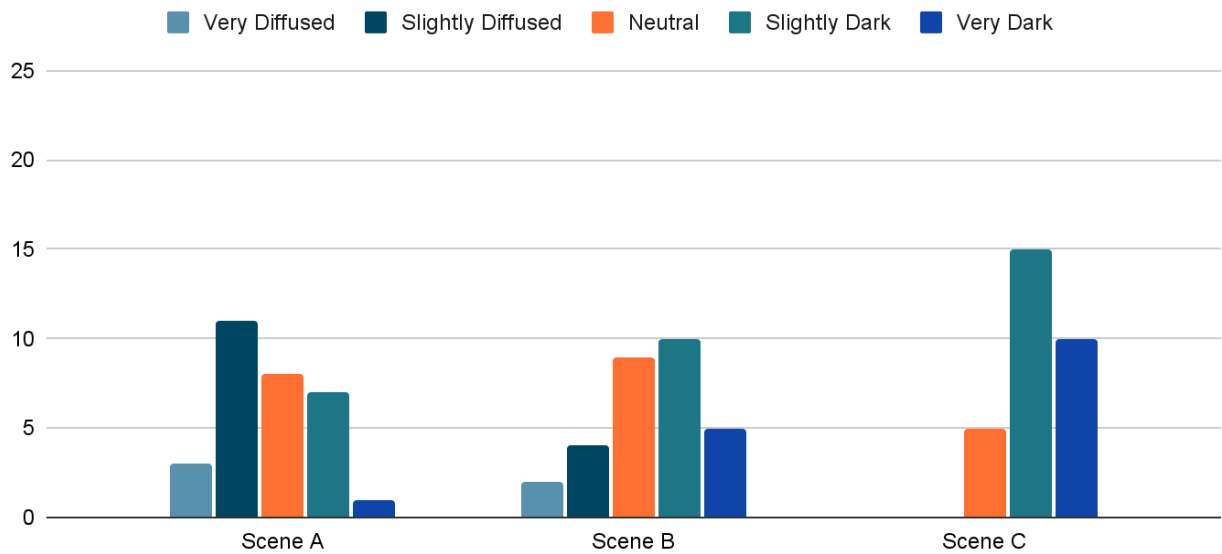

PART 2 - Questionnaire based on V/P Theory

Question 12

What do you think about the light levels (amount of light on the surfaces) in different scenes during the experiment?
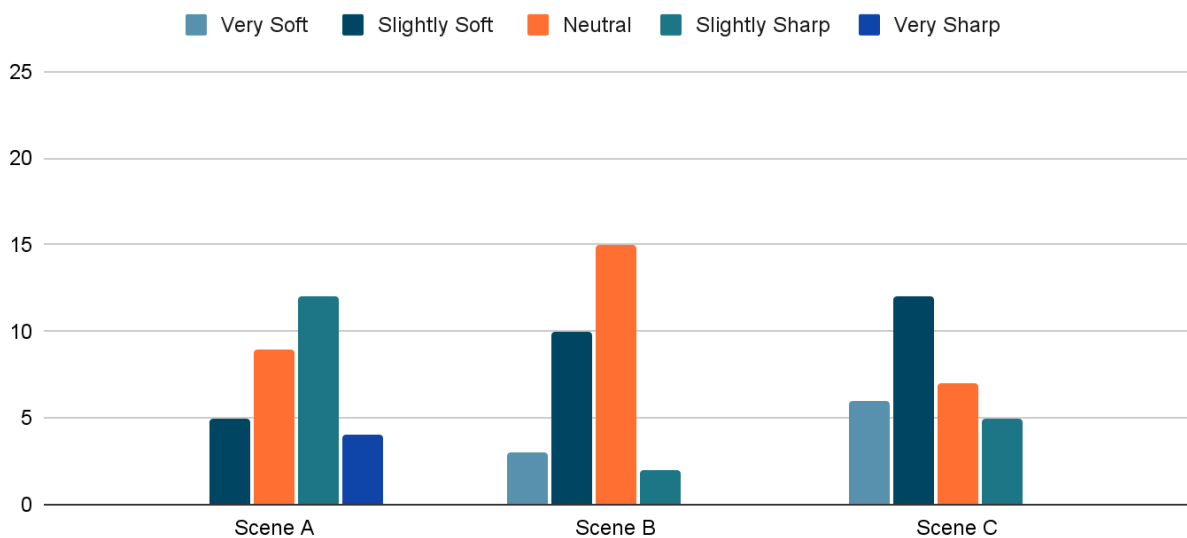
Question 13

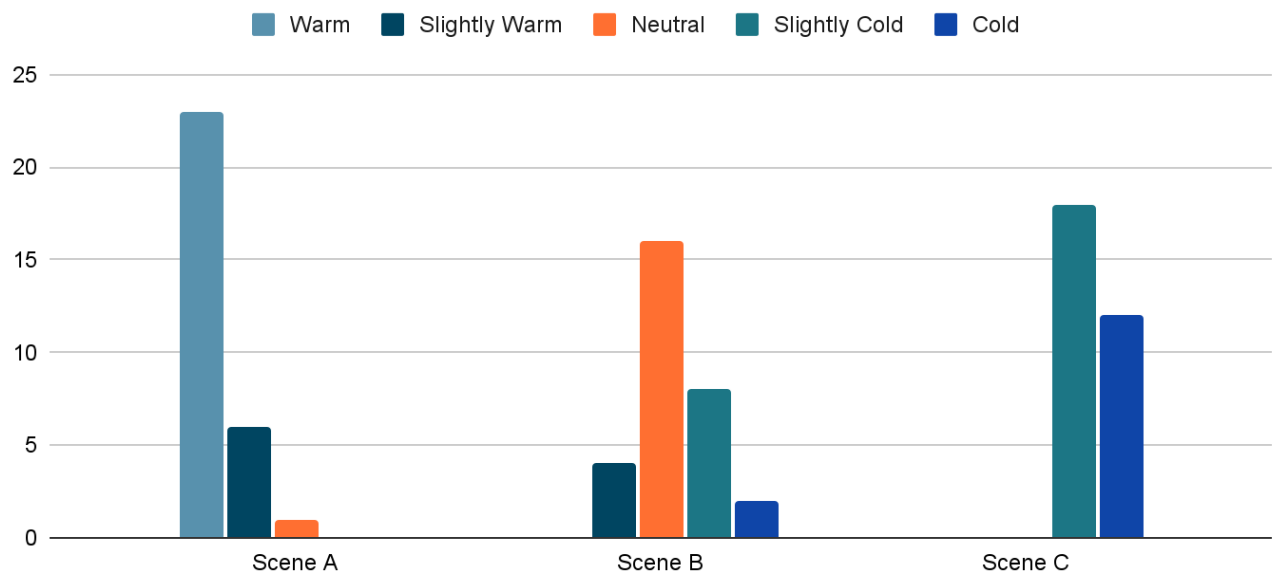What do you think about the shadows in different scenes during the experiment?

Question 14

What do you think about the water reflections in different scenes during the experiment?

Question 15

What do you think about the color tone of light in different scenes during the experiment?

Question 16

Please rate the impression of the indoor spaces in all scenes.

Name of the Scenes	A	B	C
Very Narrow	1	3	11
Narrow	3	20	15
Wide	19	6	3
Very Wide	7	1	1

6.2 Appendix II

What is Visual Perception (V/P Theory)?

V/P Theory is found by Anders Liljefors(2015). In his V/P Lighting Theory, Anders Liljefors makes a distinction between visual and physical entities. According to Liljefors, there 7 factors for the visual perception. These are;
- Level of light
- Spatial distribution of light
- Shadows
- Reflections
- Glare
- Color tone of light
- Color

 Use of green color and green-tinted light in daily life;
As it is mentioned above, Cherry(2022) explains that the green color is motivating, calming, and optimistic. Also, in our daily life green light is used to emphasize the feeling of safety. Depending on the culture, green color is the most common color for the exit signs [Image 9]. Moreover, in traffic lights, green light means that it is safe to go ahead whereas red color means stop[Image 10].

Image 9
Exit Sign
[URL : https://bit.ly/3Nu4r2b]

Image 10
Traffic Lights
[URL: https://bit.ly/3wLTh1V]